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Pinning Down Social Vulnerability to Climate Change in Sindh, Pakistan: From Narratives to Numbers, and Back Again

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Pinning Down Social Vulnerability to Climate Change in Sindh, Pakistan: From Narratives to Numbers, and back

Abstract

The paper reports critical reflections on the results of a vulnerability assessment process at the household and community scale using a quantitative Vulnerabilities and Capacities Index (VCI). We validate a methodology for social vulnerability assessment at the local scale in 62 villages across four agro-ecological/livelihood zones in the Sindh province of Pakistan. We find that the move from vulnerability narratives to numbers improves the comparability and communicational strength of the concept. Vulnerability’s depth and nuance can, however, only be realized through a return to narrative. We therefore urge caution that the index be used in conjunction with qualitative assessments and not instead of them. More substantively, the results show that vulnerability is more a function of historico-political economic factors, and cultural ethos than any biophysical changes wrought by climate., The emerging gendered vulnerability picture revealed extremes of poverty and lack of capacity to cope with present day social and environmental stresses.

Keywords: Vulnerability, Vulnerabilities and Capacities Index, Sindh, Pakistan, Gender.

Climate Vulnerability: From Narratives to Numbers

Vulnerability is a foundational concept within the hazards tradition and its more fashionable off shoot of disaster risk reduction (DRR) and climate adaptation (Bassett and Fogelman 2013). The concept has multiple definitions and conceptualizations, which broadly understand it either to be an outcome of biophysical threat, while others tend to define it as a state of being dependent upon political economic factors and one’s social positionality. This paper decidedly engages with the concept in its political economic sense. When it comes to climate vulnerability though, the question of biophysical future climate stress often occludes the present day political economic factors driving vulnerability (e.g. Tyler and Moench 2012). Ambivalence about the drivers and importance of social vulnerability to climate change may also be a function of uncertainty on how to measure it, and better incorporate it into policy. In this paper, we validate a methodology for measuring social vulnerability and reflect upon the results of a vulnerability assessment study undertaken in sixty two

villages, across four agro-ecological/livelihood zones in the four districts of the Sindh province in Pakistan (Figure 1).

[FIGURE 1 ABOUT HERE]

We understand vulnerability here to mean susceptibility to suffer damage from environmental extremes by virtue of one's social positionality, and relative inability to recover from that damage (Adger 2006, Cutter 1996, Mustafa 1998). Vulnerability is embedded in everyday power relations and political economy, inflected by class (Mustafa 2005, Pelling 1998), gender (Sultana 2010), and ethnicity (Bolin 2007) among other factors. This means that vulnerability is highly contingent upon the social context, dynamic and co-produced through evolving social and power relations.

We recognize that the research community has not been very successful in imparting the full import of the concept to the policy realm, and part of the reason for that is the policymakers' lack of affinity for nuanced qualitative information. We therefore ventured to use a quantitative index following Mustafa *et al.* (2011), to assess the variance in household and community level vulnerability, and to see if the numbers could be validated by the more customary -at least in the critical realist and political ecological tradition- qualitative information. The move from vulnerability narratives to numbers is primarily motivated by the recognition that quantitative information is likely to be more comparable across contexts and will furthermore, provide a simpler tool for decision making.

The quantitative and qualitative vulnerability assessment results presented in this study on the one hand present a picture of differential household and community level vulnerability. The policy implications of being able to quantitatively and visually plot social vulnerability are obvious, e.g., for resource allocation, targeting interventions and even disaster relief. The quantitative vulnerability index calculations along with the qualitative information also draw attention to the material, institutional and attitudinal drivers of vulnerability. Those drivers, as we will demonstrate through our vulnerability assessment results are in fact embedded in the political economic context of Pakistan, and are scantily related to biophysical risks that emerging from climate change. The vulnerability assessment, following Wescoat (1991) and Taylor (2015), therefore points towards the importance of focusing on the social drivers of vulnerability in the present, as a best strategy to adapt to future climate change.

Geographical Research Context

Pakistan, like most countries in the global South, is experiencing a socioeconomic transition, principally the transition from purely rural and urban livelihoods

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towards mixed urban/rural (desakota) livelihoods (The Desakota Team 2008). The existing hydro-climatic regimes coupled with human social systems offer formidable enough challenges to securing sustainable livelihoods, ecosystem services and welfare gains (Mustafa 2013). The challenges are likely to become even more formidable through the double exposure to climatic and socioeconomic systemic change (Leichenko and O'Brien 2008). The four districts of Dadu, Thatta, Badin and Tharparkar were chosen with the above context in mind. Table 1 illustrates the distribution of villages by agro-ecological/livelihood zone by district.

[TABLE 1 ABOUT HERE]

Sindh is the lower part of the Indus River system's surface irrigation system. Most of the population density as well as agricultural productivity of the province is based upon canal irrigation. The canal irrigated villages are however, divided into two zones, the ones with fresh and the other with saline groundwater respectively. The villages with fresh groundwater have the choice of supplementing inherently scarce canal water with groundwater irrigation, while the villages with saline groundwater do not. This is important in terms of choice of crops and sustainability of livelihoods between the two zones. In Sindh the non-canal irrigated regions are invariably based upon pastoral or agro-pastoral livelihood systems. This classification captures the issues of villages in those categories. Finally the category of riverine and estuarine fishing communities captures the vulnerability profile of these much neglected communities within this eco-livelihood system.

Within each village around 20 households were randomly selected for inclusion in the survey. Two adult members from each household, one male and one female, were interviewed to ensure sex-disaggregated data. Despite the patriarchal norms of the rural Sindhi society, we also engaged in the exercise of further disaggregating the household data into men and women-headed households (MHH n = 1102 & FHH n = 157 respectively). This classification, though problematic, as it may legitimize hierarchical, typically male dominated power structures at the household level (Buvinic and Gupta 1997), was nevertheless useful in helping us understand gendered vulnerability. In addition to the questionnaires, two focus group discussions, one each with males and females were also conducted in each of the study villages. The findings from the two sources were further rechecked through shared learning dialogues (SLDs) (Moench and Dixit 2007) with key informants, government and civil society representatives and decision makers in each of the districts to get their perspective. The questionnaire development was above all influenced by our concern to test the quantitative Vulnerabilities and Capacities Index (VCI) to capture the variance in vulnerability across and within our analytical categories. It is to the discussion of the VCI that we now turn in the next section.

Vulnerabilities and Capacities Index (VCI)

Most of the social vulnerability research in the past has been based upon qualitative research presented as narratives to capture the nuances, complexities and inter-linkages of factors contributing to differential patterns of damage (e.g. see Collins 2009, Cutter *et al.* 2000, Halvorson 2003, Murray 2009). In the policy world, however, it is very rare for textual material to be the basis for action. Most decision makers are looking for concise preferably quantitative information, which is generalizable over larger populations and can help ranking and prioritizing target populations and activities respectively. However, as Hinkel (2011) argues, vulnerability assessments are more appropriately done at local scales where systems can be narrowly defined and with fewer variables. He did not find macro level vulnerability assessments particularly enlightening because of the complexity of factors involved at higher scales. The VCI is accordingly also an instrument for vulnerability assessments at the local scale, which could convey meso-scale picture if done extensively enough.

Wisner *et al.* (2004) formulated a Pressure and Release (PAR) model to illustrate the progression of vulnerability from structural root causes to dynamic pressures to unsafe conditions. The PAR model is in the venerable chain of explanation (CoE) tradition in political ecology where everyday geographies of power imbricated with the political economy are implicated in local level environmental problems, including vulnerability to hazards (Van Dyke 2015). The vulnerability picture conveyed by the VCI can be theoretically interpreted from the PAR lens, for example to apprehend the structural and institutional drivers of vulnerability.

Mustafa *et al.* (2011) formulated VCI as a theoretically driven, but empirically informed assessment tool, which could be used to capture household and community level vulnerability profiles quantitatively. The index identifies twelve drivers of vulnerability, which are divided into three categories following Anderson and Woodrow (1989) into material (individual assets, livelihoods, education, and exposure to hazard), institutional (e.g., social networks, extra-local kinship ties, infrastructure, warning system, employment and minority status) and attitudinal (knowledge and empowerment) vulnerabilities. The original formulation of Vulnerabilities and Capacities Matrix by Anderson and Woodrow (1989) is one of the most commonly used instruments for qualitative participatory vulnerability assessments across the global South (see e.g. ActionAid 2005), and therefore, the VCI builds upon the strengths of this tested instrument. There are four version of the VCI: rural household and community level VCI and urban household and community level VCI. For the research presented here we only used the rural household and community level VCI

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matrix (Table 2). The rural community level VCI roughly addresses the same parameters as the household level VCI, with some modifications to the relative weights and substituting community unemployment rates for dependency ratio (for details please see Mustafa *et al.* 2011).
[TABLES 2 ABOUT HERE]

The twelve drivers of vulnerability, which are a part of the architecture of the VCI, are identified based upon their significance in the vulnerability literature, or what Hinkel (2011) calls the deductive approach. The weights assigned to the variables are based upon the normative judgment of the authors and their distillation of the vulnerability literature. Whilst the universe of vulnerability drivers is practically infinite, the assumption of the VCI is that the twelve drivers that are part of it will explain a preponderance of the variance in household and community level vulnerability. There is a proliferation of vulnerability indices (e.g. see Vincent 2004; Khan and Salman 2012, Boshier *et al.* 2009, Luers *et al.* 2003, Rygel *et al.* 2006), but this is one of the few instruments, which has been peer reviewed. Accordingly, we chose to empirically test this instrument for the vulnerability assessment exercise.

It is important to note that VCI is a tool for *comparative* analysis rather than an absolute indicator of vulnerability. A higher VCI score would mean a higher level of vulnerability and vice versa. However, while interpreting the results of the VCI survey one must bear in mind that: (1) it is capturing a static snap shot of what is essentially a dynamic process, (2) It is based upon the South Asian experience and may have to be modified for different contexts, (3) the VCI score is for comparative purposes only and by itself it does not mean anything and therefore it is important that weightages are applied consistently across field sites, (4) its simplicity is its strength but also its weakness in that it will inevitably miss some complex interlinkages, and (5) it must not be used by itself but rather in conjunction with qualitative information.

The above limitations notwithstanding, VCI scores can provide a simplified snapshot of differential vulnerability that can be an invaluable tool for action. Even the limitation of interpreting the VCI scores by themselves can only *partially* be overcome with a big enough sample (e.g. n = 1259 here) and by running Jenk's Natural Breaks Optimization method to classify the data into groups of high, medium, low and resilient populations. Jenk's method is a data clustering method that classifies the data by maximizing the variance between categories and minimizing the variance within categories (Jenks 1967). The results of the Jenk's routine on the VCI data are presented in Figure 2.

[FIGURE 2 ABOUT HERE]

The VCI score boundaries for the categories as outlined in figure 2 are as follows:

- Resilient 0-37
- Low Vulnerability 38-50
- Moderate Vulnerability 51-59
- High Vulnerability 60-66
- Very High Vulnerability 67-74
- Extreme Vulnerability 75 and above

This empirically derived global classification can provide a further simplified tool for policy makers to interpret the results of any VCI exercise. The remainder of the VCI scores presented in the next section should be interpreted with these categories in mind.

Results: Vulnerability Across Agro-Ecological/Livelihood Segments in Sindh

The VCI yielded considerable variance between household level data points as well as the community level. The average household level vulnerability scores for communities were significantly correlated with the community level VCI (Comm-VCI) scores calculated using the rural community level VCI template. The Pearson's correlation test between the two numbers indicated Sig = .000 and a Pearson's Correlation statistic of .603, thereby indicating a significant but moderately strong correlation. The moderate strength of the correlation is a function of the internal diversity of household level VCI scores within communities (Figures 3, 4, 5 & 6). The point, however, is that if one is pressed for time and resources to not be able to undertake household level-VCI (HH-VCI) analysis a quick use of the Comm-VCI can yield good enough results (see Mustafa *et al.* 2011). The types of variance reflected in figures 3, 4, 5 & 6 could be useful information for decision makers to prioritize communities for DRR and vulnerability reduction type of interventions.

[FIGURES 3, 4, 5 & 6 ABOUT HERE]

Drivers of vulnerability: Low social capital and access to water for irrigation

We will briefly go over some representative households (HH) and the stories we know of them to illustrate why they fall where they do on the HH-VCI spectrum. Many of the single mothers, widows and divorcees in our sample tended to have very high VCI scores. This was partially because of patriarchy driven social stigma attached to women headed household, but also because of fragile livelihoods of such households. Being alone was, however, not enough for a high

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vulnerability score, e.g., one of the highest VCI scores 86 (extremely vulnerable) was for, Bhago -an 80 year old illiterate widow from the agro-pastoralist village of Mondro in district Tharparkar- who has a house full of children and grandchildren, but still has a HH-VCI score of 84. Her 46 year old son is in prison, while her 45 year old daughter in law is a daily wage worker and a livestock trader. Her one grandson aged 14 manages livestock for local landlords and the grand daughter aged 12 does some embroidery work to bring in some money. Nobody has had any schooling in the household and they do get some supplementary income from the government's social protection programme called the Benazir Income Support Programme (BISP). This HH has high vulnerability because of no reported extra-local kinship ties, which could be source of help, no awareness of any warning system, nor access to any infrastructure. They are also highly indebted because of food expenses, something that the VCI does not address.

Whilst almost all female headed households (FH-HH) are extremely vulnerable (modal VCI 79, n=157), there are instances of male headed household (MH-HH, modal VCI=63, n=1202) that are also extremely vulnerable, e.g., Mahmud from the coastal island fishing village of Ghulam Dhablo (Comm. VCI = 70) in district Thatta, heads one such household. He is a young man of 25 with a 23 year old wife and three minor children. While his wife is a full time home builder, Mahmud is a fisherman, who used to fish locally, but now has to go up to 90 km from the coast to catch any fish. That is largely a function of overfishing by commercial trawlers in the coastal zones and contract fishing allowed in the coastal waters since the late 1990s (Gowdy and Salman 2011). He owns his fishing boat and a net, which are his only assets. What particularly distinguishes him is that he is estranged from his community and has no access to any associational life or access to leadership structures. His vulnerability is largely a function of very high vulnerability of his community (modal VCI = 73), and many of the factors contributing to his vulnerability are common in his village, with the exception of his household's exceptionally low social capital.

On the lower end of the spectrum, Abdul Rahim from village Khat Lashkar in district Dadu has a VCI score of 40. Khat Lashkar is a canal irrigated village at the head of a canal with fresh groundwater. Rahim lives with his three brothers, a wife and mother. His wife has a college education and the mother is also educated. He has a government job as a stenographer in Karachi, while one of his brothers has an agricultural income, and the other two are unemployed. The household is well equipped with electrical appliances, e.g., a refrigerator, television, and flat iron, and they own a motorbike for transportation. The household did not report any associational membership, or extra local kinship ties, but they did report good linkages to community and local leadership structures. Comparable case studies were found, mostly in the canal irrigated

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3 areas of households with rich associational life, multiple sources of household
4 income and access to relatively good infrastructure, which had low vulnerability
5 scores. In agro-pastoral villages too, we found case studies of households with
6 low vulnerability, largely on account of diversity of income and high social
7 capital. Again, here the canal-irrigated geography is a historic artefact (to
8 understand the historical reasons for contemporary vulnerable geographies in
9 the Canal Colonies of Pakistan please see e.g. Gilmartin 1994; 2013, Ali 1988, and
10 Michel 1967) determining lower vulnerability for some, and mere survival and
11 high risks for others. The British colonial authorities deliberately settled, who
12 they perceived to be loyal at the heads of water courses with large estates show
13 that they could become the leadership for the rural society, owing their position
14 to the British Empire. The inability to cope with the present (and high
15 vulnerability scores) is not just for those excluded altogether from the canal
16 colonies, but also within them for those who are landless or at the tail end of
17 canals.

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19 While the above sample household studies can validate the types of VCI scores
20 derived from the survey, we must also caution against over reliance on these
21 scores for assessing gendered vulnerability. The VCI does a competent job of
22 capturing gendered vulnerability at the higher end of the spectrum. But at the
23 lower end, the scores can often obfuscate higher gendered vulnerability within
24 households. This point will be thrown into sharper relief as the VCI scores at the
25 community level are validated through qualitative information.

26 27 The Tale of Communities beyond Households and their VCI Scores

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29 In this section we discuss four villages, representing each of the agro-
30 ecological/livelihood zones. The community profiles will illustrate why there is a
31 difference in the comm-VCI between the communities.

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33 In the inland fishing village of Haji Khair Din Mallah on Manchar Lake in district
34 Dadu (Comm-VCI = 68, HH-Mean = 67). The majority of people in the village
35 previously lived on houseboats on Manchar Lake. Until 1990, there were 45,000
36 to 50,000 people living in the lake. In 2010, the actual population had dwindled
37 to less than 20,000 people. The main cause of this decline was the World Bank
38 funded construction of the Right Bank Outfall Drain (RBOD), to drain agricultural
39 effluents and municipal waste from low lying lands and communities on the right
40 bank of the River Indus to the sea. The project is still ongoing but in the interim
41 since 1996, the main spinal drain of the project—Main Nara Valley Drain
42 (MNVD) dumps all of the waste into Manchar Lake (Birwani and Noshirwani
43 2014, SPDC 2015, Ghaus et al. 2015). Since completion of the drain, the waste
44 flowing into the lake has destroyed the fisheries and destroyed the water quality
45 of the lake, with disastrous consequences for the community:

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We sold out our boats in time of need, when we could not get a livelihood from them. Now if anyone wanted to buy a boat it would be nearly impossible because it costs 2 to 3 lacs (hundred thousand) rupees. Sometimes we struggle for one meal a day when we get no fish from water. As we are Mallah, we just know fishing profession only, and we have no experience or skills for any alternate profession (FR, Haji Khair Din Mallah).

Previously we did fishing with males in every activity at equal level and had more economic activities and had very prosperous life (FR, Haji Khair Din Mallah).

As the above quotes illustrate, not only was an entire way of life is lost as a consequence of the changes brought about by the MNV drain, but these also had deleterious consequences for gender relations in the communities, not the least of which was the burden of fetching low quality water (see Figure 7). Whereas previously women were actively engaging in livelihood activities, they are now restricted to the domestic sphere. Therefore, the high vulnerability score of the village is not separate from question of development, and the gendered impact that such transformations have on livelihoods and mobility.

[FIGURE 7 ABOUT HERE]

Things are comparably bad in the agro-pastoral village of Ramlani in Tharparkar district, a moderate sized village in the middle of the desert with no access to a motorable road, electricity, or health facilities (Comm-VCI = 79, HH-Mean = 74, HH-Mode = 75). The nearest health facility is 60 km away, and the primary school in the village is not functional because there is no teacher. In the desert environment of the village, the lives of women and children largely centre around collecting water. A government-installed tubewell in the village yields only brackish water, and the nearest fresh water source for the village is about 8 km away. Women and children are largely responsible for obtaining water, forcing them to walk to the water source once a day in the winter, and up to three times in the summer months. There is a significant amount of seasonal male out-migration to irrigated areas in other parts of Sindh or to cities such as Hyderabad and Karachi. In their absence, the women reported much higher workloads, though they also enjoyed greater autonomy in decision-making. Sometimes women also have to migrate with their able bodied men in search of work and water, rendering the elderly and the sick in the community particularly vulnerable.

Not all agro-pastoral villages fare as badly as Ramlani. The people in the village of Besarno (Comm-VCI = 57, HH-Mean = 62, HH-Mode = 63) have managed to mitigate their vulnerability by diversifying their income through employment

with the military and the government. As a consequence of that, they report having access to local leadership structures, as well as three deep wells for fresh water. Boys' and a girls' primary schools are also present in their village.

In canal-irrigated villages with fresh groundwater, things are significantly better, especially if the village is at the head of canal. In Khat Lashkar, district Dadu (Comm-VCI = 46, HH-Mean = 55, HH-Modal = 49), the more than 2,500 residents mostly live in brick and cement built housing and have access to amenities, including schools, propane gas, in-house hand pumps, electricity and a motorable road, though there is no health facility. The nearest basic health unit is about 2-3 km from the village. Most of the respondents from the village were college educated, engaged in the teaching profession, and had employment with the government and the private sector, in addition to the customary agricultural income. Moreover, this village featured relatively higher levels of educational attainment than all of the other villages in the sample (53% of the females in the sample were educated).

The increased well-being and financial capital of the household translates into more control over women's mobility as 'symbolic capital' aimed at displaying its increased status (see Siegmann and Thieme 2011).

Most neighbourhood females were working in the field for agriculture, but since the past 15 to 20 years the females in our tribe have changed. Our livelihood has changed and therefore we are not working as agricultural labour . . . Now we are more religious and our males do not allow us to move about and insist that we cover with veil (FR, Khat Lashkar).

Many of the women attending the focus group discussion in this village were wearing a burqa, which is not a traditional dress in Sindh. Greater prosperity and education, which ostensibly contributes to lower vulnerability has gendered outcomes: women face less drudgery, but the control over their bodies (decreased mobility, increased gender segregation, purdha) is used as a symbol to portray the increased economic status of the household. Such outcomes may contribute towards greater gender differentiated vulnerability, which the raw VCI score is unable to capture in this instance.

In canal-irrigated villages with saline groundwater at the tail end of canals, things are much different. The highly vulnerable village of Varshi Kohli (Comm-VCI = 73, HH-Mean = 74, HH-Mode = 75) is in district Badin and all of its approximately 450 residents are Hindu migrants from neighbouring Nagarparkar. Apart from a boys' primary school and a seasonal motorable road, the village has no infrastructure or facilities, e.g. electricity. Some hand pumps are functional, but they mostly deliver brackish water. The residents of the village are largely associated with wage labour in the area, though some people

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still maintain landholdings in Nagarparkar, from which they derive an income. The village is quite close to the Left Bank Outfall Drain (LBOD)¹, which is a source of flooding for the village. Flooding in 1984, 1994 and 2011 displaced the village population who was forced to temporarily go back to Nagarparkar. Ironically, while they migrated because of lack of water, they are periodically displaced because of too much water. Other canal irrigated villages with saline groundwater, however, have done better. Mano Khan Chandio (Comm-VCI = 49, HH-Mean = 54, HH-Mode = 51), located at the head of a canal has high levels of male educational attainment, and diversified livelihoods. Yet, this village too displays forms of gendered vulnerability where only 11% of women are educated and suffer from restricted mobility as an outcome of increased prosperity.

The variance in the Comm-VCI amongst the illustrative communities discussed above is largely on account of diversity of income, access to levers of power and then to a lesser extent access, to different types of infrastructure. While exposure to different types of environmental hazards is relatively similar across the villages, it is how each of the village is positioned within the political economy of Pakistan that seems to be at a premium. The canal irrigated villages regardless of the quality of groundwater seem to be have significantly lower VCI scores, which seem to get higher the further down the canal the village is, than the agro-pastoralists or the fishing villages (Figure 8). But even there, the actual variance within the samples should caution one from jumping to technologically driven conclusions about the utility of canal irrigation in mitigating vulnerability (also see Taylor 2015 and Mustafa 2002). Location along the canals is a very historically contingent process, which was often an outcome of deliberate social engineering undertaken by colonial and post-colonial state (Gilmartin 1994, Mustafa and Akhter 2013). Also, the lack of significant difference in Comm-VCI between saline and fresh GW is a surprise, being that the canal water is the sole source of water for agriculture and domestic use, and the villages do not have the option to supplement canal water with groundwater. We were expecting the vulnerability to be much higher than it is, because of that.

[FIGURE 8 ABOUT HERE]

Whilst on the one hand these case studies convey how the community VCI score can be indicative of the relative vulnerabilities of the communities, on the other hand, they underline the need to go beyond the numbers to understand the specific drivers and configurations of community vulnerability. The numbers

¹ The LBOD is the result of a World Bank funded project to build a spinal main channel to drain brackish water from southern districts of Sindh on the left bank of the Indus and put it in the Arabian Sea.

point to something interesting happening, but it is the qualitative information, which provides the explanation for vulnerability, to which we now turn.

Climate Vulnerability: From Numbers to Narratives

Despite the thrust of the argument so far on socially determined vulnerability, the biophysical affects of climate change are not irrelevant to the changes going on in Sindh. As the biophysical effects are mediated by societal forces that amplify or diminish their impacts, it is difficult to pronounce judgment on whether a particular impact is a direct consequence of climate change, e.g.,

June 15 was the time when the rains would always come, now it is unpredictable. There is more heat and increase in temperature. June and July were the summer months but now there are longer periods of heat. In the past in April and May there was no heat (MR, Mondro, Tharparkar).

The two most important climatic changes reported by the communities were extremes of temperature and change in the timings of the rains impacting agricultural and pastoral rhythms. These changes seemed to be coupled with people's perception of changes in the flora and fauna. But the impacts of these changes manifested themselves upon a rural economy itself in a state of flux, where people have switched their agricultural production from onions, for example, to cotton, thus increasing water demand, and their housing architecture from adobe mud houses (which are naturally insulated, hence cool in summers and warm in winters) to the electricity dependent burnt brick and concrete housing. Furthermore, environmental hazards like floods were considered to be the most damaging climate-related hazard. In a highly manipulated basin like the Indus, floods are mostly a function of the basin's human transformation (e.g. see Mustafa and Wrathall 2011).

Regardless of the biophysical versus social sources of the climatic stress, the impacts are definitely gendered, starting with lack of early warning systems:

We (women) never get any prior information (e.g. about cyclones) from any source. Now males are alert and they are getting news from the radio (FR, Gul Muhammed Ahmedani, Badin).

If we face anything like a disaster it could be a difficult situation for women to shift to another place as being part of rigid and customary tribe we will not be allowed to shift to camps, since we are not allowed to face any alien or outsider (FR, Juber Jee, Dadu).

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Once an extreme event is underway, in a society with gendered lines of power and livelihoods, the manifestations of it are also inevitably gendered (see e.g. Sultana 2014; Mustafa et al 2015). Gendered power relations are often internalized, and are therefore much harder to confront:

Domestic violence in this tribe is common and women take it as their life routine and they have no objection to it. It is man's honour and it is his right to beat women since women are not very intelligent, so they make mistakes and men always correct it, so sometimes they beat them (FR, Juber Jee, Dadu).

Vulnerability is also embedded in the fragility and stresses of the so-called 'normal' life (see Hewitt 1983, Wisner *et al.* 2004). The differentiation in workloads by gender is one example of that fragility in the field study villages. In more well to do villages, there are increasing limits to female mobility, while in case of poorer communities women face more workload and longer working hours.

Pattern of activities is we wake up at 5.00 am, start day with prayer and then cooking, washing, skilled work (knitting fish net, crochet work, tailoring). We have some livestock so collect fuel wood, carry out collection and drying of cow dung. After dinner then bedding and if [...] electricity allows us so we also chat and do some skilled work late at night (FR, Manchar Lake, Dadu).

We fetch water from the well. We go twice to fetch water for household chores, in the morning and evening, and each time it takes 2-2 ½ hours. If anyone has livestock they have to go more often (FR, Besarno, Tharparkar).

Those working hours are also inflected by the increasing monetization of the, previously moral economy, e.g.,

In this area there is only one hand pump in another village, but if anyone takes water from that, the people of that household have to pay PKR.500 per month for the water. Since we cannot afford PKR. 500 we have to walk for two hours to get water (FR, Ibrahim Bhatti, Thatta).

There are three main third order impacts that are worth mentioning in the context of gendered impacts of changes underway in the rural society of Sindh: nutrition, health and labour migration. Many communities described ensuring adequate nutrition as difficult even in 'normal' circumstances, because income

from agriculture and livestock has fallen, the natural flora and fauna have been depleted, and food inflation has increased. While the drop in food quality and quantity affects whole families, it is women who appear to bear the heaviest load, and are most vocal about this concern.

In the past there was less heat and we spent less. Now things are very expensive. We only eat vegetables. We cannot afford meat or eggs, it is too expensive, but sometimes the men eat eggs (FR, Dondio Meghawar, Tharparkar).

The food we eat has changed; we had vegetables, now we eat red chillies and roti (bread). Because of the drought we cannot grow food (MR, Amji Jo Goth, Tharparkar).

I had more than 35 goats and a couple of cows, but all those drowned in the recent floods. Now it is impossible for me to even buy one goat (FR, Haji Abdullah Halepoto, Badin).

It is very tough to meet needs on a daily basis, with the limited amount for food... especially in this time of high inflation like a Kg of flour costs Rs. 40-45. Due to shortage of food, first we serve to children and males; few times we females have to survive without meals (FR, Jam Babbar, Tharparkar).

The health situation of the study communities paralleled that for nutrition: they appeared to be suffering already from health issues like fever, malaria, malnutrition, diarrhoea, skin rashes, jaundice, liver problems, kidney stones and gynaecological issues. The health situation was further exacerbated by the increase in women's workload, limitations on their mobility and changes in the health system from a more traditional low cost system to a more commercial western medical system. In times of natural disasters, the situation further deteriorates, with particularly dire consequences for women:

For maternity problems there is no Lady Health Worker or trained *dai* (midwife) available, so in any emergency we rush to Piyaro Khan Town where we get female doctor; it is 10 km away and in general we get treatment which costs around Rs. 1,000, but in delivery cases and other maternity cases they charge Rs. 5,000 to Rs. 7,000 which is not affordable by any poor person (FR, Juber Jee, Dadu).

Some women get gynaecological problems, which are chronic as they could not afford to go to hospital frequently. (FR, Gul Muhammed Ahmedani, Badin).

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We cannot move without permission of our males; in emergencies too we have to take a male otherwise we are not allowed to take them (sick women) for health emergency (FR, Khat Lashker, Dadu).

As the above quotes illustrate, one of the more insidious consequences of male outmigration, in addition to the increase in women’s workload, is not being able to access health care. For example, to approach anybody beyond a husband for transport to the health facilities for gynaecological problems would be unthinkable, meaning the women just suffer in silence.

The ethnographies presented above highlight specific aspects of gender vulnerability differentially affecting people’s capability to cope with socio-economic and climatic changes. In particular, existence early warning system, health, nutrition, monetization of the economy and hence inflation, women’s work loads and limits on their mobility emerge as the main contributors to vulnerability. Almost all of these factors are embedded in the cultural ethos and political economy of Pakistan, which accentuates the experience of heat stress and other hazards, such as floods. The narratives of vulnerability complement and nuance the findings of the VCI, e.g., the VCI can capture if there is an early warning system and if it is known by a respondent, but it cannot capture differential knowledge of the early warning system between men and women. The VCI may capture the proximity of health services, but it does not capture their quality or affordability. This is true of many other factors that are not part of the architecture of the VCI. The extraneous factors outside of the architecture of VCI end up impacting the ones that are a part of it, e.g. poor health may impact livelihoods, that VCI does capture, but the chain of causation must ultimately be disentangled through qualitative ethnographic information.

Whilst there is evidence for the changing biophysical context of their lives, it is unclear how independent are the impacts of those changes, and on balance how much more important than the social context of patriarchy, transition to a monetized economy, and commercialization of agriculture and fishing. We offer some reflections on the efficacy of the methodology that helps us uncover these stories and the substantive valence of those stories in the concluding section.

Conclusion: Climate Challenges are Yesterday’s News

The variance in comparative vulnerability across the household and community scale is reflected well in the VCI scores. The VCI scores are furthermore, confirmed by the customary (in the critical realist/political ecological tradition) qualitative vulnerability assessment. Our field staff (whose level of education ranged from high school to some college level) were able to understand, and calculate the VCI scores for households and communities, while at the same time

documenting the basis for their VCI scores, as well as household and community profiles. This gives us confidence that the instrument is not only robust in conveying the variance in vulnerability, but also easy to use in most field environments, especially in the global South. From DRR, to adaptation to even disaster relief, mapping the VCI profiles would help prioritize and target the most vulnerable households and communities. In terms of post disaster relief provision in particular, lack of pre-existing knowledge about the vulnerability profiles of communities causes chaotic relief delivery where some communities end up getting too much, while others get nothing, e.g., see Ozerdem (2006) for the Kashmir earthquake. Long-term developmental interventions could similarly use the tool to understand the key drivers of vulnerability and undertaken interventions on how to address them.

Narrative vulnerability is important and has enriched our understanding of the concept and its drivers. However, there is a pragmatic imperative to move from narratives to numbers. VCI is a useful tool to fulfil that imperative. But having moved to numbers, one must inevitably again move back to narratives to understand the stories behind the numbers. Numbers are not a substitute but rather a supplement to narrative forms of vulnerability assessments. This is especially true when it comes to gendered vulnerability. The VCI instrument is good at highlighting vulnerability at the higher ends of the spectrum, but the hidden gendered vulnerability in the middle reaches of the VCI spectrum is only discernable when the numbers are combined with the narrative vulnerability assessment.

The evidence in this article has also highlighted, that the very urgent present of the survey respondents and communities is defined by extremes of deprivation, marginalization, lack of coping ability and differential vulnerability. We have highlighted that the lack of coping ability and vulnerability is not a function of exposure to climatic extremes, but rather of how households and communities are positioned within the political economy of Pakistan. More favoured access to irrigation water at the head of a canal in fresh groundwater zone is a distinctly human artefact, as is the degradation of the Manchar by overfishing and a World Bank funded project, or the hazards emerging from the LBOD. Vulnerability is more a function of historico-political economic factors than any biophysical changes wrought by climate change and are likely to remain so. Women's enhanced vulnerability is a function of the patriarchal ethos of the rural Sindhi society, but also of increased work loads borne of poverty, monetization of the economy, and male out-migration. Then perversely, at times, the drudgery for more affluent households is replaced by greater restrictions on female mobility as a source of symbolic capital. The VCI helps highlight that urgent present of differential vulnerability, while the ethnographies uncovered the gendered aspects of it—especially in the low to mid range vulnerable households, where

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the apparent picture of less vulnerability hides higher gender based vulnerability within the household.

We have proposed and validated a methodology in this article, which may help communicate that urgent present, as viewed through the vulnerability lens, to the policy realm. More than thirty years of vulnerability research has helped enter the term into the policy lexicon but the actual policy informed by rigorous vulnerability analyses remains elusive. Hopefully this methodological engagement with vulnerability to climate change helps address that theory and practice gap.

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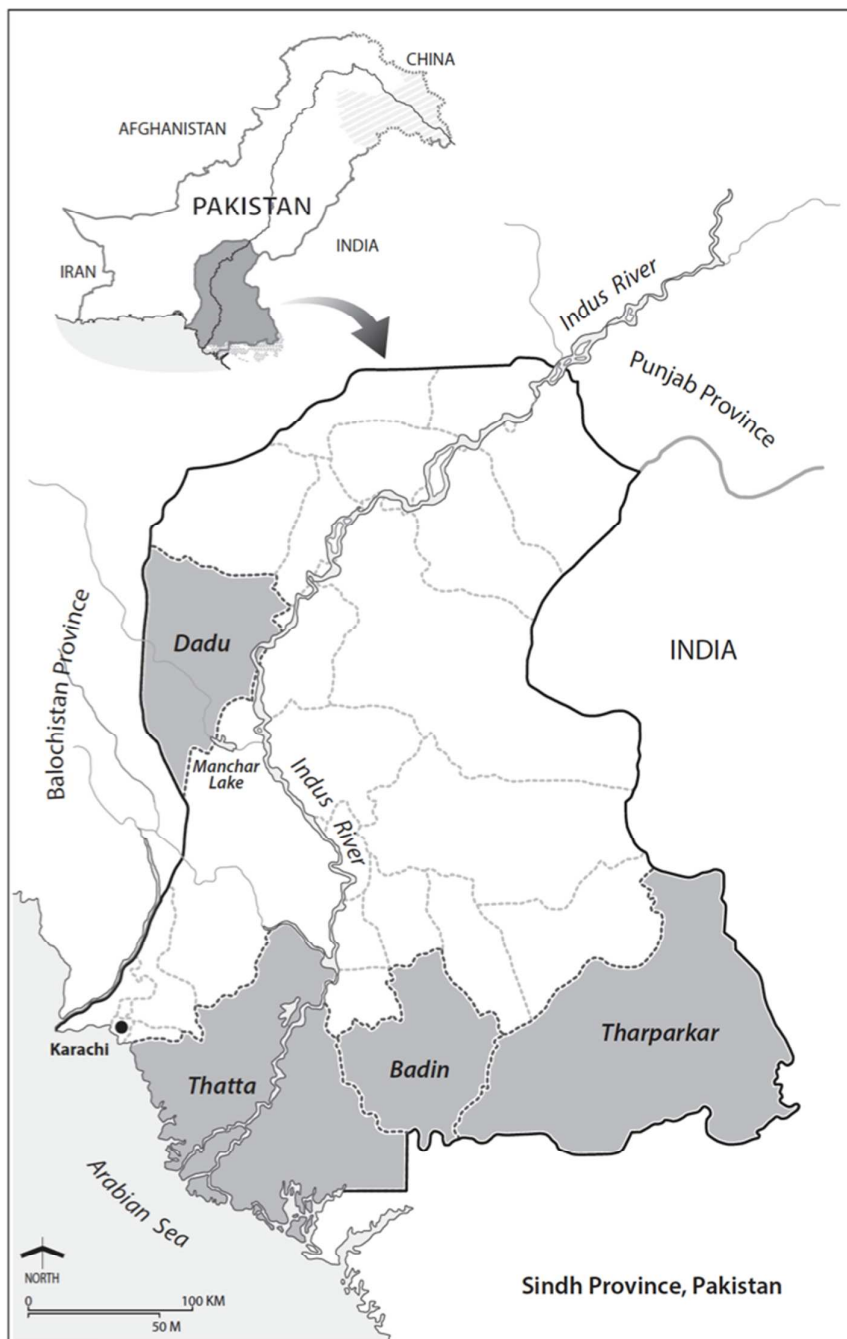


Figure 1: A general map of Sindh with the study districts.

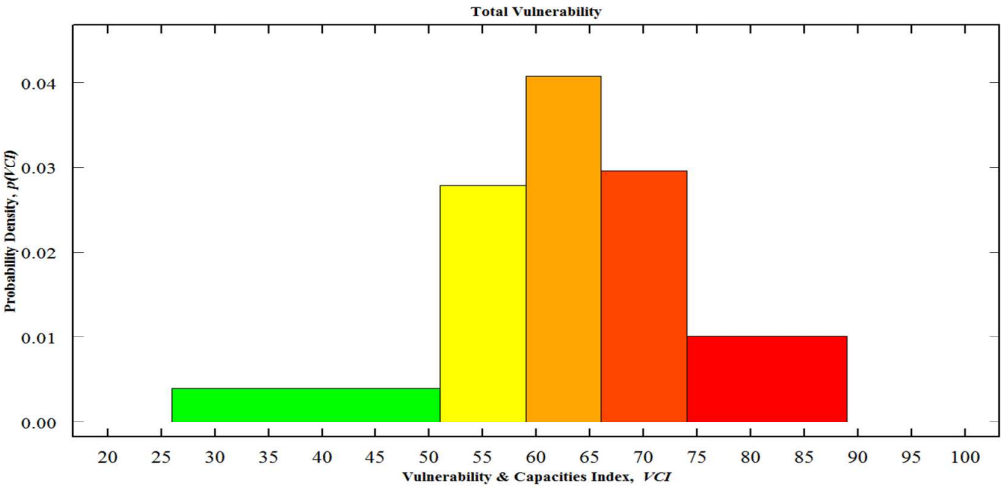


Figure 2: Distribution of categories--resilient, low, moderate, high, very high and extreme vulnerability.

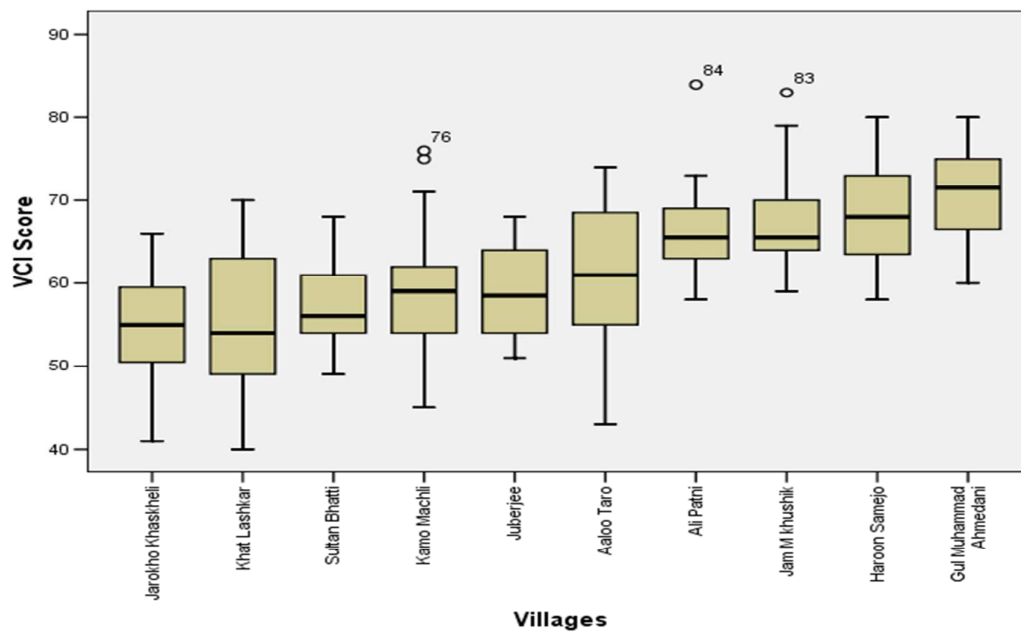


Figure 3: Box plots for HH-VCI scores of villages with canal irrigation and fresh groundwater.

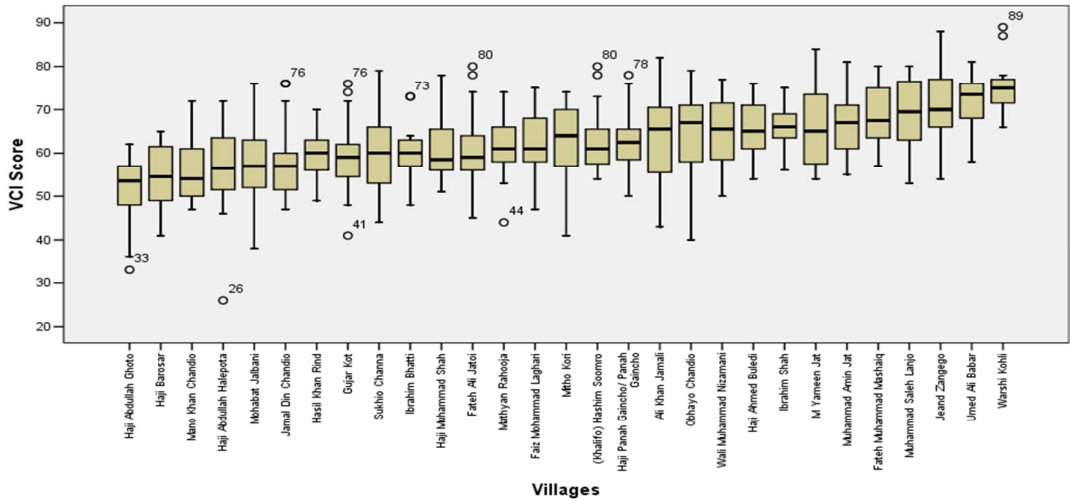


Figure 4: Box plots for HH-VCI scores of villages with canal irrigation and saline groundwater.

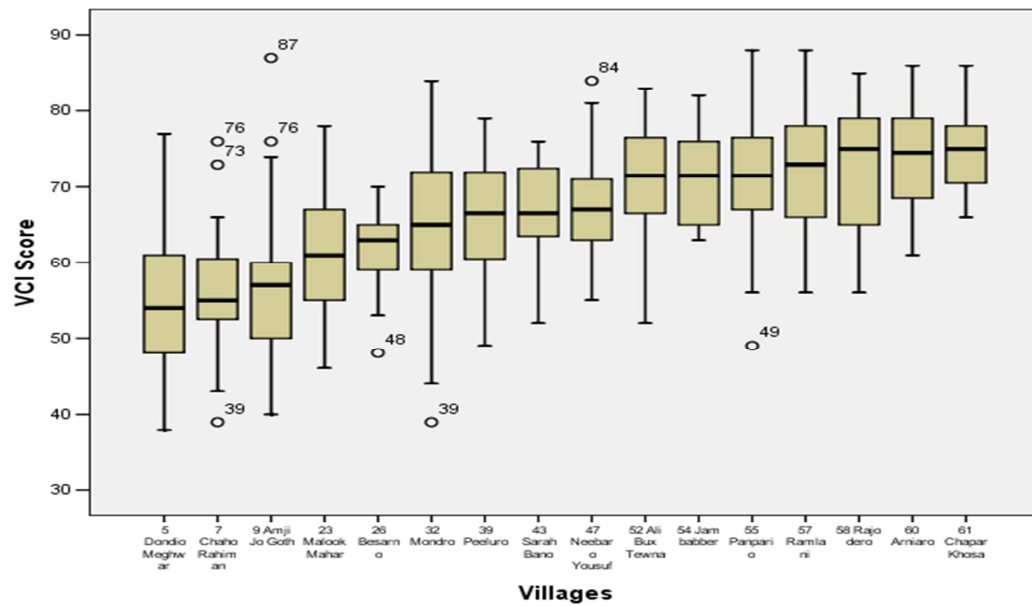


Figure 5: Box plot for HH-VCI scores for agro-pastoralist villages.

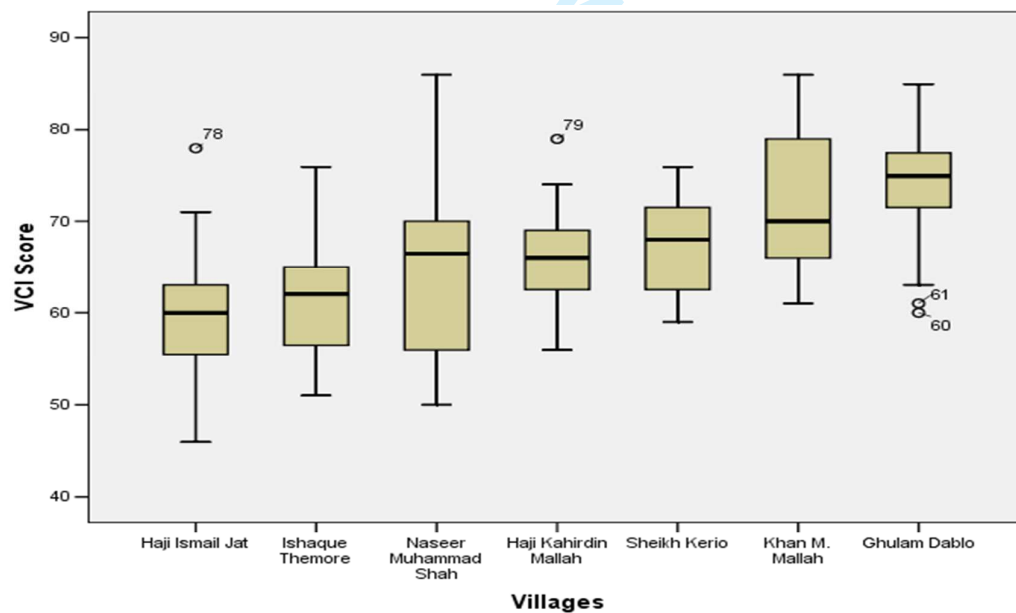


Figure 6: Box plot for HH-VCI scores of fishing villages.

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Figure 7: Women scooping up brackish water from a groundwater source. Previously, they would have depended on the Manchar Lake water.

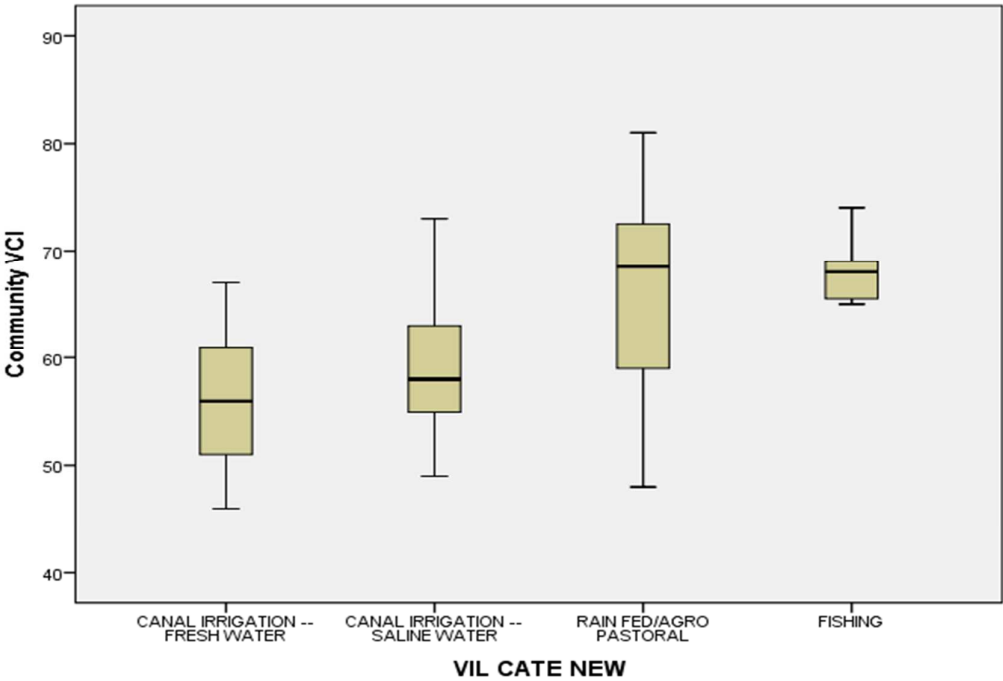


Figure 8: Difference in aggregated household VCI scores between different agro-ecological/livelihood zones.

Table 1: Number of villages included in the study by agro ecological/livelihood zone

		Badin	Dadu	Tharparka	Thatta	Total
Canal (fresh groundwater)	Irrigated	2	5	0	4	11
Canal (saline groundwater)	Irrigated	12	7	2	8	29
Agro-pastoral		0	3	13	0	16
Fishing		1	2	0	3	6
Total		15	17	15	15	62

Table 2: A Composite Vulnerabilities and Capacities Index for the Household Level in Rural Areas (HH-VCI) (Source: Mustafa *et al.* 2010).

		Vul	Cap
	Material Vulnerabilities	35	
1	<u>Income Source:</u> Start Value <ul style="list-style-type: none">Start value represents 100% dependency on a local level productive asset (e.g., fisheries, land, small shops, etc.).Add 2 to the score if the income sources are unstable (e.g., daily labor).Subtract 2 if the local income sources are stable and insensitive to local hazard.Lower score by 1 for every 10% of non-local income reported.	10 +2	-2 -1 per
2	<u>Educational Attainment:</u> Start Value <ul style="list-style-type: none">Start value represents no member of the household being literate.Lower score by 1 for every 5 years of schooling of the most educated male member of the household.Lower score by 2 for each female member's 5 years of schooling.	5	-1 per -2 per
3	<u>Assets:</u> Start Value <ul style="list-style-type: none">Start value represents no immediately fungible assets (e.g. farm implements, animals, jewelry, savings, household items).Lower score by 1 for every Rs. 20,000 of fungible assets. -Will have to be calibrated empirically.	8	-1 per
4	<u>Exposure:</u> Start Value <ul style="list-style-type: none">Start value represents location in high likelihood impact area relative to the prime hazard (e.g. household is located within the 10 year floodplain).Lower the score by 1 for every level of decreased impact likelihood between household location and high impact likelihood area (e.g. subtract 1 for each 10 year floodplain delineation).Lower score by 1 for each instance of hazard mitigation (e.g. building of a house on higher plinth for floods, low cost construction which could be rebuilt with local resources).	10	-1 per -1 per
	Institutional Vulnerability	50	
5	<u>Social Networks:</u> Start Value <ul style="list-style-type: none">Start value represents no household memberships in ethnic, caste, professional, or religious organizations.Lower score by 1 for each organization a household member	10	-1

	<p>belongs to.</p> <ul style="list-style-type: none"> For each organization that has provided assistance in the past, lower the score by 2 times the proportion of respondents reporting the organization to be efficacious. 		<p>per</p> <p>-2* (prop) per</p>
6	<p><u>Extra-local Kinship Ties: Start Value</u></p> <ul style="list-style-type: none"> Start value represents no extra local kinship ties. Lower score by 2 for every immediate family member living extra-locally. Lower score by 1 for every non-immediate family member living extra-locally. 	5	<p>-2 per</p> <p>-1 per</p>
7	<p><u>Infrastructure: Start Value</u></p> <ul style="list-style-type: none"> Start value represents lack of access to water, telecommunications, electricity, roads, and healthcare. Lower score by 4 if household located has nearby access to a sealed, all-weather road OR Lower score by 2 if household located near a seasonal road. Lower score by 2 if household has access to clean drinking water. Lower score by 4 if household has mobile coverage. Lower score by 4 if household can access a local medical facility. Lower score by 2 if household has access to electricity 	16	<p>-4 or -2 -2</p> <p>-4 -4</p> <p>-2</p>
8	<p><u>Warning Systems: Start Value</u></p> <ul style="list-style-type: none"> Start value represents lack of a warning system, or warning system that the HH is not aware of or doesn't trust. Lower score by 4 if warning system exists and is trusted. 	4	<p>-4</p>
9	<p><u>Earning Members in a Household: Start Value</u></p> <ul style="list-style-type: none"> Start value represents a household consisting only one earning member. Add 5 to score if single parent headed household. Lower score by 1 for every additional earning member. 	5 +5	<p>-1 per</p>
10	<p><u>Membership of Disadvantaged Lower Caste, Religious or Ethnic Minority</u></p>	+5	
	Attitudinal Vulnerability	15	
11	<p><u>Sense of Empowerment: Start Value</u></p> <ul style="list-style-type: none"> Start value represents no participation in or access to leadership structure at any level. Lower score by 10 if household is self-declared community leader and/or has declared active participation in 	10	<p>-10</p>

	community decision making. <ul style="list-style-type: none">• Lower score by 10 if household has declared access to regional or national leadership structure.		-10
1	<u>Knowledge: Start Value</u>	5	
2	<ul style="list-style-type: none">• Start value represents lack of knowledge about potential hazards.• Lower score by 1 for every type of hazard and related potential impacts accurately listed by respondents.		-1 per
	Total Vulnerability Score		-----
	Total Capacity Score	-----	
	Combined Vulnerability and Capacity Score		
	Highest Possible Vulnerability and Capacity Score	100	